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ABSTRACT

This study focuses on an evaluation of the graduate programs designed to prepare science educators at Temple University. An opinionnaire, which consists of 20 statements reflecting the Science Education faculty's positions on certain aims of the graduate program, was developed for this study. This opinionnaire was distributed to the faculty and to four other groups which included graduates of the doctoral program, doctoral students at the time of the study, masters degree program graduates, and students enrolled in the masters program. Demographic data were also collected from the different groups. The analysis of the data showed that a high degree of agreement existed among the five groups in the way they viewed the aims or standards and the actual performance of the Science Education graduate program at Temple University. (HM)

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INTERNAL FORMATIVE EVALUATION OF GRADUATE LEVEL

SCIENCE EDUCATION

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RESEARCH REPORT:

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FOREWORD

Sir Edmund Percival Hillary reached the summit of Mt. Everest on May 28, 1953. A stupendous "First"! But the little-acclaimed photographic record of the entire expedition -- from preparation to culmination at 29,029 feet -- elevates the achievement far beyond the conquest of Everest. It makes it a classic example of the most humanizing of our human values, imagination. Not only to climb, but to record the process is to anticipate one's role in history; it is to perceive one's potential responsibility to future climbers whatever their summit; it is to plan for and muster and husband the reserves of energy to exceed the climb in recording its accomplishment.

The analogy to the present study will become evident in the pages to follow. The graduate program in Science Education at Temple University represents fifteen years of assiduous planning, professional dedication, and probing self-evaluation. In this period some 300 science educators have earned the masters degree and more than 50 administrators, elementary and secondary school teachers and college professors have won through to the doctorate. In the immediately past five years three internal evaluation studies within the Department of Secondary Education paved the way

for Dr. Trotter's sharply focused assessment of the program in Science Education.[1]

In her research Dr. Trotter looks at the adequacy of the teacher education phase of the Science Education program. She examines the concept of "accountability" at the level of teacher preparation; she assesses the results of the Temple University program in the context of accountability. The condensation of her study presented here follows a familiar pattern of research reporting. In Part I, Dr. Trotter lays out briefly the purpose, scope and procedure that characterize her work. In Part II she provides historical perspective on accountability and related evaluation studies. In Part III she details procedures followed. In Part IV she analyzes data gathered. And, in Part V she reveals the value of her study as a formative evaluation which is at once summary and projection into the emerging phases of program development.

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[1] Professor David Kapal initiated an internal evaluation in 1972. Professor Willard Gandy directed a preliminary survey of 115 doctoral candidates in 1973. In the same year Professor Stiles Seay coordinated an extensive student evaluation of teaching and supervision in all areas within the Department. In 1974 Dr. Barbara Trotter, together with Professor Frank X. Sutman (then Chairman of the Department of Secondary Education) and Professor Joseph Schmuckler (Coordinator of the Science Education program) designed the study reported here. It should be noted especially that other members of the Science Education faculty; Professors' Matthew Bruce, Donald Humphreys and Eugene Udell, were deeply involved in periodic shaping and guidance of the study as it progressed.

All of us in the Science Education faculty join in endorsing Dr. Trotter's work. Further, we are sharing it with several hundred colleagues in Science Education elsewhere, to whom we commend it.

We will welcome your comments.

Signed,

Francis X. Sutman

Francis X. Sutman,
Director MERIT (bilingual) Center
and Professor Science Education

July, 1979

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PART I

CONTEXT, PROBLEM AND PROCEDURE

> Now, here, you see, it takes all the running you can do to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!
>
> (The Red Queen in Through the Looking Glass, 1941 ed.)

Lewis Carroll's classic lines can be used to describe the situation of public education in the more than thirty years since the end of World War II. During this period educators have responded to greater numbers and varieties of pressures than ever before. The growth in college enrollment caused by the influx of returning GI's the need to accommodate to the post-war baby boom, and now the decline in school age populations are but a few examples. The rush to develop scientific expertise after the launching of Sputnik in 1957, is another. One response to these pressures on the part of professional educators has been a proliferation of curriculum materials (Goodlad, 1974), experimentation with organizational and administrative forms (Hanson, 1975), and the development of an ever increasing number of evaluation techniques and models (Welch, 1974).

For the American public these same pressures have resulted in an increased awareness of the importance of education. We see this in the number of books, both

scholarly and popular, which have become best-sellers: Conant (1959, 1967), Coleman (1966), Kozol (1967), and Illich (1971).

The recent Gallup Polls of Public Attitudes Toward Education (Gallup, 1972 through 1977), reflect the willingness of the public to express attitudes toward public education. It is true that the attitudes reported are somewhat ambiguous. For example, from 1972 until 1974, more than half of the respondents replied that they believed students were receiving a better education than they themselves had received. However, both the 7th (1975), and 8th (1976) polls show less than 50 percent assigning and "A" or "B" rating to the public schools. Further indication that the public wants to make its feelings known about the performance of schools is reflected in a growing insistence on open school board meetings (Downey and Mullins, 1976), defeat of bond issues (Piele and Hall, 1973), and demand for a greater voice in the day-to-day administration of the schools (Goodlad, 1975). It is in the context of this critical societal background that this present study was conceived and carried out.

Statement of the Problem

The school, in conjunction with the family, has long been considered the primary social institution responsible

for a child's total development. This would appear to place responsibility for this development not only on teachers who are the child's immediate contact, but also on the spectrum of administrators and curriculum developers who determine the nature of educational programs. Often overlooked in assigning responsibility are members of another eschelon of educators - the teachers of teachers.

It is clear that a consideration of programs which prepare teachers of teachers, designers of curriculum and administrators, is essential in the overall assignment of responsibility in the educational undertaking. Since the adequacy of almost any program is judged in terms of outcomes or "products" (Welch, 1974), it is essential to determine an appropriate technique for evaluation of these particular programs.

The present study focuses specifically on an evaluation of the graduate programs designed to prepare science educators at Temple University. The study employs the Provus Discrepancy Model which, as we shall see presently, has proved useful for the evaluation of graduate science education programs and other comparable programs elsewhere.

Purpose of the Study

This study was designed primarily to enlist answers to the question:

> Is there agreement among past graduates, the graduate students enrolled at the time of this study, and the faculty as to the aims and expectations of graduate programs in Science Education at Temple University?

The answers have contributed data which is useful in formulating recommendations for the future direction of Temple's graduate programs in Science Education.

In addition to the primary question three others were phrased to provide valuable data on Temple University's graduate population:

1. Who are the graduates and graduate students of Science Education at Temple University?
2. To what degree do they attribute the career success to experience at Temple University?
3. What suggestions do graduates and those students enrolled in program at the time of this study make for changes in the program?

Beyond answers to informational demographic questions, the study sought to validate the applicability of the Provus Discrepancy Model for a specific area of interest, at a stated educational level, in a chosen institution.

Scope of the Study

Graduate programs in Science Education at Temple University had their beginnings in the 1950's when the general curriculum in both the Elementary and Secondary Education Departments included an option to emphasize Science Edu-

cation. Until 1964, each of two faculty members devoted approximately one-third of their load time to teaching courses and advising students who wished to emphasize Science Education. By 1965, however, two faculty members, in part supported by funds from the National Science Foundation, gave full time to Science and Science Education activities. By 1966, a nucleus of candidates for the M.Ed. and Ed.D. were enrolled in Science Education. By 1970, the Science Education faculty had grown to include the equivalent of eight full time faculty. Programs and students in the middle '60's and into the early '70's, continued to receive major financial support from the University and from the National Science Foundation and the United States Office of Education.

While the present study examines the graduate level Science Education programs as they evolved over the past fifteen years, a time period of three years was deemed adequate for sampling. The years 1972 to 1975 were arbitrarily chosen to provide a cross section of faculty and students who had been involved in the program for a varying number of years. All students enrolled in post-bacculaureate programs between September, 1972 and May, 1975, were included; faculty members instructing in science education during that same time span also participated. However, this population totally had contact with the programs over the approximately fifteen year period.

The five general stages of the model as identified by Provus in his analysis of educational programs, are: design adequacy, installation fidelity, process adjustment, product assessment, and cost-benefit assessment. For this study the following specific loops were identified: agreement of students and faculty on perceived conditions (i.e., performance), agreement of students and faculty on optimal conditions (i.e., standard), and the difference (i.e., discrepancy) between what is perceived as existent and what is seen as optimal by each group.

If data at the first identifiable stage indicate lack of agreement, no standard for the evaluation may be set. If there is agreement (i.e., W significant) then the standard is established. Once a standard is established, the performance of the program is measurable. If extreme discrepancy is found, then adjustment is called for in the program being evaluated.

There are advantages to this type of formative evaluation system based on discrepancy information obtained from data collected from participants in an on-going program. First, the program can be adjusted, if necessary, at any point in its operation without having to wait for long term results. For example, a course might be added, or a new

teaching method introduced; in more traditional models the need for such innovations cannot usually be determined until graduates are employed. Secondly, the inputs into a program evaluated by discrepancy means can be used for adjustment without the need for complete restructuring. Re-assessment can be made at any time and basic assumptions and performance criteria may be altered or added as needed.

In this study, comparison of the judgments of five groups on "what is" and "what should be" and the measured discrepancies are treated statiscally. These statistical data provide the basis for recommendations directed to the graduate Science Education programs at Temple University. Before presenting the statistical data and an analysis of it, it will be useful for the reader to consider from the literature a brief historical perspective on the areas to which the study is related. These two areas of concern are accountability and evaluation.

PART II

PERTINENT LITERATURE

In preparing to apply the Provus Discrepany Model to an evaluation of the Science Education graduate programs it seemed reasonable to consider literature in the following areas:

1. The development of the concept of accountability
2. The evaluation of graduate programs in teacher education
3. The history of evaluation as it relates to presently used models

Concept of Accountability

The idea that learning carries with it implications for the future is not new, nor is the idea that the teacher is responsible. Two thousand years ago Seneca (The Troades, 1917 ed.) stated:

> The mind is slow in unlearning
> what it has been long in learning . . .
>
> Let the teacher beware lest
> his pupil be unready for
> his life.

Seneca's thoughts have persisted, as Taggart (1974) points out:

> By the nineteenth century, education was defined as the total shaping of an American, and unless schools delivered on their promise to fulfill this broad definition for all Americans, they were believed to be failing in the popular mind.

This concept of accountability, which many mistakenly consider to be an out-growth of the last three decades (Lessinger, 1970), was recognized and described early in the century by such educators as E. P. Cubberly, who comments in his The History of Education (1920) on the development of a normal school to train teachers, "adequate to prepare emerging students for the business of life in accord with (their parents' expectations)."

This same concept is expressed by Frank Hewett (1966), who argued that as early as 1903, during the Thorndike era, teachers were held responsible for the outcomes of their teaching. The implications of accountability in education can be found in the writing of others, such as Bobbit (1924), Dewey (1929), and Charters (1951).

Perrone and Strandberg (1971) sustain the focus twenty years later when they state:

> In its most basic form accountability responds to the question: How much are we (taxpayers) getting for our money? Can our children read, perform mathematical computations, get a job?

And Taggart again reminds:

> Americans have always assumed a high correlation between educational and social and economic success for several decades. In the minds of parents, success in the outside world has become so dependent on school success that schools are thought of as the prime instruments of social mobility. Accountability proponents promise educational success in the guise of skill training as if the three R's will automatically provide life success.

The principle of accountability has developed along several lines, each of which may become the direction of an observable trend. One such direction is legal accountability at the school level. This direction is exemplified by Popham's (1970) support of the use of behavioral objectives. An extension of the use of behavioral objectives seems to underlie the 1971 Stull Act which still requires California teachers to be evaluated in the light of student achievement, which is to be determined "by school boards, superintendents, or other qualified parties" (California Code Chapter 36, Section 40, Article 5.5, No. 13485 - 7 - 9). The consequences of the Stull Act were reflected in one court case among others: Peter Doe vs. San Francisco Unified School District. The case was argued on the grounds that schools had the absolute responsibility to guarantee their product, namely literate students (Sorgen et al., 1973). Although this case was decided against Peter Doe, similar cases have been filed in several other states (Newsnote, 1977). Legal activity related to accountability in the schools has resulted in California and Florida, for example, in formal state laws governing accountability.

Rating teachers in terms of student performance has also been used in teacher dismissal cases. In Schnellhaase vs. Woodbury Central Community School District, the low scores of students on a national achievement test was the

reason given for not renewing the contract of a non-tenured teacher. When the case was appealed to the U.S. Circuit Court, the dismissal was upheld (Nolte, 1975).

Another direction in accountability is under serious study in at least seventeen states (Rosner and Kay, 1974). This direction approaches accountability at teacher training institutions. A consideration of this direction and of where accountability lies is expressed by Temple University faculty members Bruce and Miller (1976) in an article specifically applicable to teacher education in science. They refer to:

> a basic characteristic which differentiates Performance Based Teacher Education (PBTE) from the general notion of performance based education. This characteristic difference lies in the relationship between teacher and the ultimate "product" (or aim) of teacher education, learning by children in schools. This product is a sort of second-order product in that teacher education is process designed to prepare its clients to do something which will, in turn enable a second order client to do something.

Bruce and Miller's contention is reasonable if we accept Aldrich's (1974) statement that "Accountability means being held responsible for something over which one has control."

A third direction in accountability relates to the viability of curriculum materials developed mainly through support of Federal agencies. This direction is considered later within discussion of the history of evaluation.

Studies in Evaluation

This brief discussion of directions taken in accountability in education can be extended to graduate education where "teachers of teachers" and educational leaders are prepared. The idea of institutional improvement based on follow-up studies of graduates has numerous precedents: Mann (1958), Pettit (1954), Beaty (1969), Sandefur (1970), and Harste (1972). These studies all deal with baccalaureate level programs.

Another significant study conducted by Ann Heiss (1967) at Berkeley deals with post-baccalaureate students. In her extensive work, Heiss questioned students from a large number of departments. The emphasis on specific course content was minimal. The study focused rather on the morale of students at different stages of graduate study, on relationships of students with faculty advisors, and on attitudes toward dissertation research. Final recommendations were directed to the entire range of doctoral studies at Berkeley.

In contrast to the Heiss study, Newton and Watson (1968), examined teacher education programs in Science Education in a number of institutions. Their study followed a survey research model.

A third example of institutional evaluation occurs in the self-studies mandated by the National Council for Accreditation in Teacher Education (see bibliography). One section

of these studies does involve the graduate program of each department. These evaluations are descriptive and do not depend upon statistical procedures. Unlike the above studies, related to evaluation in higher education, the study reported here considers a single specialized area at a single university, and utilizes an instrument which includes items for which common criteria were established. The study reported here attempts to assess graduate programs in Science Education at Temple University, using an adaptation of the Provus Discrepancy Model which involves non-parametric statistical analysis.

Evaluation in Education

Prior to considering the Provus Model of Evaluation, it will be helpful to place it in perspective in relation to several early attempts at evaluation that do not consider evaluation as an on-going process. Through this comparison the appropriateness of the Provus Model, which is formative in nature, will be better understood.

Before 1930, the field of evaluation was almost entirely dominated by standardized tests, many of which had their origins in 1905, when Binet and Simon constructed the first usable intelligence test. A reliance on the predictive ability of these tests, especially after Terman's variation was recognized as the Stanford-Binet test in 1916, (Terman, 1916 and 1919) is characteristic of this period. An example of the unquestioning faith in these tests can be

seen by reviewing a 1932 case, West vs. the Board of Trustees of Miami University. Performance on a newly standardized test to measure academic achievement was the basis for the student's dismissal. His defense was argued on the grounds that he had successfully passed another such test, and therefore the second test was not valid. The decision went against the student, and the judge ruled that the second test was "obviously improved" and therefore "more valid" (Chambers, 1933).

It was not until the initiation of the Eight-Year Study in 1935, which introduced periodic evaluation and assessment, that any real change in emphasis in evaluation studies could be detected. Ralph Tyler is usually credited with the formulation of the guidelines for establishing the evaluation programs which were an outgrowth of the Eight-Year Study (Taylor and Cowley, 1972). These guidelines laid the foundation for almost all work in educational evaluation from the 1930's through the 1950's. During this period there was an emphasis on describing objectives and on measuring the performance of students before and after particular courses (Dressel and Mayhew, 1954).

It was only with the founding of the National Science Foundation in 1952, and the passage of the National Defense Education Act six years later, that evaluation assumed a new function in education. It came to be viewed by legislators as a way of accounting for public monies spent for curriculum development. Aldrich calls this "the real issue of

accountability" (1974). Overnight it seemed, every government-sponsored curriculum project was required to contain some built-in evaluation procedure (Haines, 1969). The repeated demand for this kind of evaluation did more than satisfy politicians; it provided the impetus to develop more useful evaluation models for education.

Systems theory had been developing prior to World War II and can be traced in the writings of such men as Ludwig von Bertalanffy (Bertalanffy and Rapoport, 1960). The computer age and the influence of industrial analysis also began to influence educators to develop evaluation models utilizing computer logic. This approach provides for the collection of data which is fed back into the system being evaluated in order to continue the operation of the system or to terminate it. Scriven (1967), Alkin (1970), and Provus (1971), all describe evaluation models in education based upon a systems approach; i. e., having a cybernetic dimension.

The essential operation in the Provus Discrepancy Evaluation Model adapted for this study, is to compare a performance to a standard, to measure the difference, and then to recommend a change of either performance or the standard.

In Part III of this research report the steps for establishing the standard through faculty interviews and for measuring the difference between the standard and performance by means of an opinionnaire are considered. The

final step, applying the Provus Model in the form of recommendations for change, is dealt with in Part V.

PART III

PROCEDURE

To examine the graduate program in Science Education at Temple University over the three year period, according to procedures adapted from the Discrepancy Model developed by Malcolm Provus (1971), several steps were necessary. A brief description and chronology of these steps follows.

The first step was to develop an opinionnaire that would determine attitudes and perceptions in a form lending itself to statistical treatment. The most significant work in this area is Rensis Likert's thesis, A Technique for the Measurement of Attitudes (1932), which describes just such a method. His use of a five point ordinal scale which does not attempt to equate the intervals has become an accepted procedure for collecting data which can be analyzed by various non-parametric designs. The opinionnaire designed for the present study makes use of a Likert scale.

Construction and Informal Validation of the Opinionnaire

Initially, a sampling of recently written materials related to the education of science teachers was examined. The assumption was made that these writings would indicate areas of concern of the Science Education faculty at Temple University, and that these concerns would be reflected in the program that was offered to the potential science educators enrolled in Temple's graduate program. It was further

assumed that these concerns were shared by the professional community of science educators. The sampling of materials come from four sources:

1. Newsletters (1971-1974) of the Association for Education of Teachers of Science.

2. The summary of the papers presented at the 1973 National Association for Research in Science Teaching convention.

3. A paper entitled "Evaluating the Effectiveness of Programs in Science Teacher Education in the 1970's" which was presented by Frank X. Sutman at the National Science Teachers Association meeting in 1970.

4. The in-house memos and bulletins of the Science Education Faculty at Temple University (1972-1975).

Based on an analysis of these materials, the following five questions were prepared:

1. In view of all the controversies surrounding education today, what would you say was your greatest single priority in teacher training?

2. Do you feel that teachers who are preparing to work in the inner city should receive different training than those who choose to work in suburbia. If so, why?

3. In considering those students who will be involved in working with different curricula: PSSC, SCIS, SAPA, CHEM, etc., should any different training be offered them?

4. What is your position on the use of "inquiry" in science teaching?

5. Do you think it is either desirable or possible to "humanize" science teaching? How? Why?

These questions were duplicated and sent to six science educators selected from the 1974 membership list of the

National Association for Research in Science Teaching. They had been participants in the field over many years and were respected by this evaluator for their contributions to the Science Education profession.

These individuals, herein after referred to as "experts", came from the following institutions: University of Maryland, Pennsylvania State University, State University College at Buffalo, State University at Syracuse, Columbia University Teachers College and Jersey City State College. Experts were deliberately selected from East coast institutions of higher education since the evaluator and the Science Education staff at Temple University were aware of differing approaches to graduate education in Science Education on the East and West coasts.

The experts were asked not only to respond to the questions, but, to answer the further question, "How relevant was each to the field of Science Education today?" The investigator then revised the questions on the basis of the experts' input, so that interiviews could be conducted with the faculty in Science Education at Temple University. The faculty members who were interviewed met the following criteria:

1. Had been a full time member of the Science Education faculty during the period of the study.
2. Had taught at least one graduate level course in Science Education each year during the period of the study.
3. Had acted as advisor to students enrolled in the

masters or doctoral degree, or C.A.G.S.* program in Science Education.

Nine individuals were identified as belonging to this faculty group. They are referred to as "faculty" here.

The assumption was made that the interviews, based on these five questions, would generate statements representative of the opinion of each faculty member. Accordingly, all the interviews except one were taped. In the exception, a written record of the responses was made. The tapes were then transcribed.

After studying these transcriptions, a preliminary list was compiled of thirty-two statements which were paraphrases of statements made by the faculty during the interviews. Several of the statements were repetitive. To eliminate repetition four doctoral students, working at the dissertation level, were consulted. An attempt to reduce potential bias was made by choosing four students who reflected the diversity of the student population in Science Education at Temple University. Two were Teaching Associates, one in secondary and one in elementary education. A third was a public school administrator in the School District of Philadelphia, and the fourth was a fulltime graduate student. The panel of students, together with the evaluator, reduced the list of statements from thirty-two to twenty through discussion and debate. The investigator arranged these twenty statements in the form of an opinionnaire, structuring it in

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* Certificate of Advanced Graduate Study

such a way that respondents could assign a numerical value to each item, using a scale from 1 (no significance) through 5 (high importance). The Kendall Concordance technique then was used to evaluate these numerical responses.

Establishing the Reliability of the Instrument

The reliability of the opinionnaire was determined by administering it to the science faculty of two local high schools. Eleven science teachers from these two schools, who had had some graduate work in Science Education, were asked to participate. The opinionnaire was administered a second time to the same group eighteen days later, in order to allow "forgetting" to take place as discussed by Steven Isaac (1971), in A Handbook in Research and Evaluation. Since only one of the teachers given the opinionnaire was currently enrolled in a class in science education, it was judged that the time span would have little probability of changing attitudes during this period of time. The Spearman formula for rank correlation was used to compare the results of the two responses and a correlation co-efficient of 0.99 was determined. The opinionnaire was therefore considered to have high reliability.

Administration of the Opinionnaire

The opinionnaire was distributed to the Science Education faculty, to enrolled graduate students in Science Education, and to recent graduates. (see Table 1). The

faculty were those identified earlier. The graduates were those who received either doctors or masters degrees during the period from September, 1972 through May, 1975. The students were those enrolled in doctoral or masters degree programs during this time period. If a masters degree program graduate was enrolled in a doctoral degree program, he was counted with the doctoral program group.

The distributed opinionnaires were accompanied by the short letter of explanation. (Appendix 1, C). Respondents were asked to check the degree of importance they believed was <u>actually</u> placed on each item in the graduate programs in Science Education at Temple University, and the degree of importance they believed <u>should be</u> placed on each item. The demographic information sheet (Appendix 1, B) was attached to each opinionnaire to facilitate grouping for the analysis. A cut-off date for receiving returns was established.

TABLE I

DISTRIBUTION AND RETURN OF THE OPINIONNAIRES

	Distributed	Undelivered	Presumed Delivered	Returned	% returned
Faculty	9	-	9	9	100
Doctoral Graduates	11		11	9	81.8
Doctoral Students	66	4	62	54	87.0
Masters Graduates	11	1	10	5	50.0
Masters Students	42	2	40	20	50.0
CAGS *	4	-	4	2	50.0
Totals and Mean	143	7	136	99	72.7

*CAGS (Certificate of Advanced Graduate Study candidates) were counted with the Masters Students in the analysis.

The final column of Table I indicates very satisfactory percentages of return: 100 percent from faculty, doctoral graduates 81 percent, and doctoral students 87 percent. The return from both masters students and graduates was 50 percent. The total return was 72.7 percent.[2]

Treatment of Data

Once the completed opinionnaires were received they were examined to determine an appropriate statistical procedure for analysis. The Statistical Package for the Social Sciences (Nie, et al., 1975), available through the U.C.L.A. Computer Center, was decided upon because it would give appropriate median values for determining differences in responses, and would summarize these data for each of the five groups considered in the study. This same program was used to summarize the demographic data presented in the questionnaires.

Following Siegel (1956), the data from the twenty statements in the opinionnaire were ranked according to decreasing median responses within each of the five groups. This ranking generated the three tables: The "should be" responses or the standard, the "is-were" responses or the performance, and the "differences between" responses or discrepancies.

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[2] Miller (1976) states that the expected return rate on a questionnaire without follow-up for a college educated population is 60 to 70 percent.

Again, according to Siegel, the Kendall Concordances were determined from the determined rankings (Appendix II, A, B, and C). Overall rankings of the 20 opinionnaire items, resulted from the sums of the rankings determined earlier. The overall rankings were used to determine those items that might well be considered for adjustment in the program by the faculty, and those that needed not be considered.

PART IV

PRESENTATION AND ANALYSIS OF DATA

Results of the Opinionnaire

Since the Likert scale utilized in the opinionnaire is an ordinal scale, the most appropriate statistic for describing central tendency was the median (Siegal, 1956). Therefore, the first step in the analysis was to find the individual item median scores for each group, namely: the faculty, the doctoral graduates, the doctoral students, the masters graduates, and the masters students.

Numerical values were assigned to item responses as follows: 1 (no importance), 2 (low importance), 3 (medium importance), 4 (high importance), 5 (very high importance).

In order to calculate the appropriate Kendall Concordances it was necessary to use the item median scores as well as the differences between each group's item medians; that is, between the way they perceived the Science Education program as it is/was and the way they judged that it should be.

The information provided in Table II furnishes data for further analysis. It also provides a basis for the presentation in Part V. The table is labeled to correspond to the twenty items in the opinionnaire; each item is understood to begin, "An aim of graduate programs in Science Education at Temple University is . . . ". The median differences are labeled with the symbol Δ. The data from Table II were used to develop Tables III.

TABLE II

MEDIAN RESPONSES AND MEDIAN DIFFERENCES FOR EACH OPINIONNAIRE ITEM

Item 1: to encourage teachers to make a strong commitment to quality science teaching.

Groups Responding	Median Responses is/was	should be	$\triangle$
Faculty	3.87	4.60	0.73
Doctoral Graduates	3.92	4.40	0.48
Doctoral Students	4.10	4.52	0.42
Masters Graduates	4.25	4.67	0.42
Masters Students	4.15	4.79	0.64

$\overline{\triangle}$ = 0.538

Item 2: to help teachers develop a mature teaching style. i.e., one which integrates cognitive, affective, and technical skills.

Groups Responding	Median Responses is/was	should be	$\triangle$
Faculty	3.12	4.75	1.55
Doctoral Graduates	3.80	4.33	0.53
Doctoral Students	3.75	4.30	0.55
Masters Graduates	3.67	4.67	1.00
Masters Students	3.69	4.22	0.53

$\overline{\triangle}$ = 0.830

Item 3: to help teachers develop skills which will lead them to generate questions about their own studies.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.50	3.50	1.00
Doctoral Graduates	4.60	4.00	0.60
Doctoral Studies	3.74	4.10	0.36
Masters Graduates	3.75	3.75	0
Masters Students	3.31	4.11	0.80

$\overline{\triangle}$ = 0.550

Item 4: to make teachers conscious of their own teaching behavior.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.00	4.25	1.25
Doctoral Graduates	2.68	4.00	1.32
Doctoral Students	3.79	4.32	0.53
Masters Graduates	3.33	4.33	1.00
Masters Students	3.43	3.80	0.37

$\overline{\triangle}$ = 0.890

Item 5: to provide teachers with useful classroom teaching techniques.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.33	3.40	0.07
Doctoral Graduates	3.60	4.12	0.52
Doctoral Students	3.94	4.35	0.41
Masters Graduates	4.67	4.33	0.34
Masters Students	4.43	4.56	0.13

$\overline{\triangle}$ = 0.295

Item 6: to provide specialized training for teachers who work in urban areas.

Group Responding	Median Responses is/was	should be	△
Faculty	2.37	2.87	0.50
Doctoral Graduates	1.50	3.00	1.50
Doctoral Students	2.71	3.31	0.60
Masters Graduates	3.12	3.12	∅
Masters Students	2.85	3.57	0.72

$\overline{\triangle}$ = 0.665

Item 7: to provide specialized training for teachers who work in suburban areas.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.25	2.87	0.62
Doctoral Graduates	2.37	3.37	1.00
Doctoral Students	2.73	2.22	0.51
Masters Graduates	2.67	3.00	0.33
Masters Students	2.90	3.33	0.43

$\overline{\triangle}$ = 0.578

Item 8: to train teachers to teach a specific national curriculum program, e.g., CHEMS, S.A.P.A., etc.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.87	2.87	∅
Doctoral Graduates	2.75	2.87	0.12
Doctoral Students	2.62	2.79	0.17
Masters Graduates	2.67	3.00	0.33
Masters Students	2.57	2.25	0.32

$\overline{\triangle}$ = 0.188

Item 9: to help teachers learn techniques which will enable them to lead their students to ask questions about science.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.12	4.37	1.17
Doctoral Graduates	3.37	4.33	0.96
Doctoral Students	3.61	4.11	0.50
Masters Graduates	3.00	4.00	1.00
Masters Students	3.57	4.29	0.72

$\overline{\triangle} = 0.350$

Item 10: to help teachers become sensitized to the environment of their own classrooms.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.80	3.75	0.95
Doctoral Graduates	3.62	3.67	0.05
Doctoral Students	3.33	4.08	0.75
Masters Graduates	3.25	4.00	0.75
Masters Students	3.05	3.81	0.75

$\overline{\triangle} = 0.650$

Item 11: to encourage teachers to develop learning materials which have an inquiry orientation.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.37	4.00	0.63
Doctoral Graduates	3.37	4.00	0.63
Doctoral Students	3.93	4.16	0.23
Masters Graduates	3.25	3.33	0.08
Masters Students	3.81	4.29	0.48

$\overline{\triangle} = 0.410$

Item 12: to help teachers recognize the inherent dignity of each of their students.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.00	4.08	1.08
Doctoral Graduates	3.25	4.00	0.75
Doctoral Students	3.63	4.15	0.52
Masters Graduates	3.75	4.00	0.25
Masters Students	2.94	3.92	0.98
			$\overline{\triangle}$ = 0.716

Item 13: to help teachers learn to use value clarification techniques.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.25	3.25	1.00
Doctoral Graduates	2.00	3.40	1.40
Doctoral Students	2.35	3.59	1.24
Masters Graduates	3.16	3.50	0.34
Masters Students	2.43	3.37	0.94
			$\overline{\triangle}$ = 0.984

Item 14: to help teachers set affective goals in their own science classes.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.37	3.87	1.50
Doctoral Graduates	2.40	3.62	1.22
Doctoral Students	2.96	4.03	1.07
Masters Graduates	3.67	3.87	0.20
Masters Students	2.78	3.71	0.93
			$\overline{\triangle}$ = 0.984

Item 15: to expose secondary teachers to elementary science programs and vice versa.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.62	4.00	1.38
Doctoral Graduates	3.25	3.75	0.50
Doctoral Students	2.69	3.58	0.89
Masters Graduates	2.33	3.00	0.67
Masters Students	2.06	3.31	1.24
			$\overline{\triangle}$ = 0.936

Item 16: to help teachers set cognitive goals in their science classes.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.92	4.00	1.08
Doctoral Graduates	2.92	4.00	1.08
Doctoral Students	3.30	3.90	0.60
Masters Graduates	3.67	4.00	0.33
Masters Students	3.00	3.50	0.50
			$\overline{\triangle}$ = 0.720

Item 17: to help teachers set psychomotor goals in their own science classes.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.62	3.12	0.50
Doctoral Graduates	2.86	3.60	0.74
Doctoral Students	2.76	3.17	0.94
Masters Graduates	3.50	4.17	0.67
Masters Students	2.40	2.94	0.54
			$\overline{\triangle}$ = 0.678

Item 18: to help teachers improve and/or broaden their own knowledge of science.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.62	4.12	0.58
Doctoral Graduates	3.87	4.03	0.16
Doctoral Students	3.15	4.61	1.46
Masters Graduates	4.00	4.68	0.68
Masters Students	3.25	4.79	1.54

$\overline{\triangle} = 0.880$

Item 19: to help teachers become familiar with the instruments scientists use i.e., spectro-photometers, pH meters, microscopes, etc.

Groups Responding	Median Responses is/was	should be	△
Faculty	3.00	3.20	0.20
Doctoral Graduates	2.87	3.40	0.53
Doctoral Students	2.89	3.82	0.93
Masters Graduates	3.67	4.25	0.58
Masters Students	2.62	4.00	1.38

$\overline{\triangle} = 0.720$

Item 20: to provide opportunities for teachers to learn to use a variety of media techniques in their teaching of science i.e., overhead projectors, microprojectors, film loops, etc.

Groups Responding	Median Responses is/was	should be	△
Faculty	2.62	3.00	0.38
Doctoral Graduates	2.40	4.00	1.60
Doctoral Students	2.69	3.70	1.01
Masters Graduates	3.68	4.00	0.32
Masters Students	2.58	3.56	0.98

$\overline{\triangle} = 0.858$

Determining Standards, Performance, and Discrepancies

For the Provus Model to result in useful recommendations, the "standards" for the program as judged by responses to "should be" items had to result from the application of similar criteria by the respondents. To test this, the Kendall Concordance was calculated for these items. As Siegal (1956) states:

> When we have k sets of rankings, we may determine the association among them by using the Kendall coefficient of concordance W . . . W expresses the degree of association among k such variables.

In this study there are five sets of rankings (k = 5), since there are five groups responding to the items. Rankings of items for each group were in the order of magnitude of the assigned priorities; that is, whether the median response indicated that an item was of no, low, medium, high, or very high importance on the "should be" scale. For example, on item 4 of the opinionnaire the median response for faculty is 4.25 (high to very high) and on item 5 of the opinionnaire the response for the same group is 3.40 (medium to high). (See Table II). Therefore, item 4 has a higher rank than item 5. For tied ranks, when median responses were identical for two or more items, a mean rank was assigned. Table III summarizes the rankings of items and median differences for each group. For all "should be" responses, W = .7619. The Chi^2 = 72.38, and the significance $< .001$.

From this data, the Kendall Concordance is judged to have a high level of significance. This means that in the perceptions of the "standards" the five groups applied essentially the same criteria in their judging; the groups simply agreed on the importance of the item. For the purposes of this study, this internal agreement on what "should be" provides the essential first loop; that is, the "standards" in the Provus Model.

In order to examine the performance measure, similar calculations were carried out on the median responses to the "is/was" items on the opinionnaire.

The Kendall Concordance, W, for all "is/was" items was calculated to be .7088. The $Chi^2 = 67.34$, and the significance $< .001$. (See Appendix II, Table B). Therefore, we may conclude that at this level of significance, the perceptions of performance were based on essentially the same criteria.

The third Concordance calculated was that of the ranking of items for each group in the order of magnitude of the median differences; that is, the discrepancies $\triangle$'s, between the way the groups perceived the program to exist and the way they judged that it should be.

For all discrepancy items W = 0.341. The $Chi^2 = 32.4$, and the significance is between .02 and .05. Within this probability range, the Kendall Concordance is considered signi-

ficance is between .02 and .05. Within this probability range, the Kendall Concordance is considered significant. This means that in the overall discrepancy ratings the five groups applied essentially the same standard of judgment.

Analysis of Average Median Responses

Table III presents the twenty items from the opinionnaire arranged from highest to lowest discrepancy value. Note from the table that the range in values is from 0.98 to 0.19, all below 1. In this ranking item 2 has an average discrepancy of 0.83, while item 12 has an average discrepancy of 0.73. This appears to be a natural breaking point in the discrepancy values. Only items with discrepancy values of 0.82 or greater are ones recommended for further consideration by the Science Education faculty. There are seven of these items.

TABLE III

OPINIONNAIRE ITEMS LISTED IN ORDER OF HIGHEST TO LOWEST DISCREPANCY

Item No.	Item Statement	Average Discrepancies
13.	to help teachers to learn to use value clarification techniques.	0.98
14.	to help teachers set affective goals in their own science classes.	0.98
15.	to expose secondary teachers to elementary science programs and vice versa.	0.94
4.	to make teachers conscious of their own teaching behavior.	0.89
18.	to help teachers improve and/or broaden their own knowledge of science.	0.88
20.	to provide opportunities for teachers to learn to use a variety of media techniques in their teaching of science i.e., overhead projectors, microprojectors, film, loops, etc.	0.86

Since the discrepancy scale range for this study is from 0 to 4, a discrepancy of 0.98 (max.) or less than 1, is considered to be insignificant.

TABLE III (continued)

Item No.	Item Statement	Average Discrepancies
2.	to help teachers develop a mature teaching style, i.e., one which integrates cognitive, affective and technical skills.	0.83
12.	to help teachers recognize the inherent dignity of each of their students.	0.72
16.	to help teachers set cognitive goals in their own science classes.	0.72
19.	to help teachers become familiar with the instruments scientists use, i.e., spectrophotometers, pH meters, microscopes, etc.	0.72
17.	to help teachers set psychomotor goals in their own science classes.	0.68
6.	to provide specialized training for teachers who work in urban areas.	0.67
10.	to help teachers become sensitized to be environment of their own classrooms.	0.65

TABLE III (continued)

Item No.	Item Statement	Average Discrepancies
7.	to provide specialized training for teachers who work in suburban areas.	0.58
3.	to help teachers develop skills which will lead them to generate questions about their own studies.	0.55
1.	to encourage teachers to make a strong commitment to qualify science teaching.	0.54
11.	to encourage teachers to develop learning materials which have an inquiry orientation.	0.41
9.	to help teachers learn techniques which will enable them to lead their students to ask questions about science.	0.35
5.	to provide teachers with useful classroom teaching techniques.	0.30
8.	to train teachers to teach a specific national curriculum program, e.g., CHEMS, S.A.P.A., etc.	

Demographic Data

In addition to the determination of discrepancy values this study collected demographic data about the graduates and students (Appendix III). Examination of these data indicates that only the data related to the present employment of graduates and students and their job satisfaction is truly related to the purpose of this evaluation study.

The data is summarized below. First the question:

Who are the graduates and graduate students of Science Education at Temple University?

As can be seen from the data, the average age of all groups during the period studied included a ten year span of 27 to 37. The majority were men. Most had undergraduate majors in science. Almost all were employed, ninety percent as teachers or school administrators. Only the doctoral graduates show a short length of time on the job, a fact probably related to job changes following completion of the doctorate.

The second question:

To what degree do you attribute your success to experiences in Science Education at Temple University?

In answer to the question, "Did you qualify for your present position as a result of your graduate studies at Temple University?", the majority responded "No." However, in answering the question "To what extent did your studies in a graduate program at Temple University contribute to your feelings of success in this position?" median responses of between

2 and 2.4 (1 highest, 5 lowest) indicated that all groups attributed a significant measure of success to participation in the program.

Finally:

3. What suggestions do the graduates and students make for changes in the program?

Since the opinionnaire was based on faculty interviews, this open-ended and final question was included in order to provide an opportunity for the graduates and students to offer additional suggestions. These comments are considered below.

> What suggestions would you make to improve the program you are now in or that you have finished at Temple University?

Many of the responses to this question were reflections of the same items considered in the opinionnaire. It is worth noting that fourteen respondents emphasized the difficulties of being a student. An examination of the data reveals that almost all of the students were employed at the time of their graduate study. In eleven instances the desirability of greater access to advisors was cited.

Twelve graduates and current students asked for a greater variety of science content courses to be offered by the College of Liberal Arts in the evenings and summer. Less often were requests made for courses with emphasis on the role of the community college (six times), administrative responsibilities, (six times), supervision (four times), and pre-dissertation research methods (five times).

PART V

SUMMARY, FINDINGS, AND RECOMMENDATIONS

This study has applied a portion of the Provus Model of Evaluation to an examination of the graduate Science Education program at Temple University. The Provus Model of Evaluation calls for summarizing findings and for making recommendations for action. These findings and recommendations follow a brief summary of the study.

Summary

In an effort to evaluate the Science Education program mentioned above, an opinionnaire was developed consisting of statements reflecting the Science Education faculty's positions on certain aims of the graduate program. The opinionnaire was distributed to five groups who were recent graduates. The groups were the faculty, graduates of the doctoral program, the doctoral students at the time of the study, the masters degree program graduates, and the students enrolled in the masters program. These groups responded to the twenty items on the opinionnaire. The responses were analyzed and the Kendall Concordances indicated that the criteria used to establish standards and to measure performance, by means of the opinionnaire items, were common to a significant degree among the five groups.

These data, as well as demographic data, was used for

recommending changes in the programs. That this process of evaluation could be completed indicates the applicability of the Provus Evaluation Model for analyzing such an educational program. That the evaluation did occur indicates the interest of the Science Education faculty in improving its program at the graduate level.

Findings

1. A high degree of agreement exists among the five groups in the way they view the aims or standards and the actual performance of the Science Education graduate program at Temple University.

2. There appears to be somewhat less, though still significant, agreement among the five groups regarding the discrepancies. In no instance was an average discrepancy greater than 1 determined. (Discrepancies of this little magnitude indicate extreme agreement.)

3. Almost complete satisfaction with the existing programs is indicated from the very low discrepancy ratings given to thirteen items from the opinionnaire presented in Table IV.

TABLE IV

ITEMS WITH VERY LOW DISCREPANCY RATINGS

Aim	Item	Average △
Classroom technique	5. to provide teachers with useful classroom teaching techniques.	0.30
	8. to train teachers to teach a specific national curriculum program, e.g., CHEMS S.A.P.A, etc.	0.18
	19. to help teachers become familiar with the instruments scientists use, i.e. spectrophotometers, pH meters, microscopes, etc.	0.72
Goal Writing	16. to help teachers set cognitive goals in their own science classes.	0.72
	17. to help teachers set psychomotor goals in their own science classes.	0.68

TABLE IV (continued)

Aim	Item	Average △
Inquiry Approach	3. to help teachers develop skills which will lead them to generate questions about their own studies	0.55
	9. to help teachers learn techniques which will enable them to lead their students to ask questions about science	0.35
	11. to encourage teachers to develop learning materials which have an inquiry orientation	0.41
Attitudes Toward Teaching	1. to encourage teachers to make a strong commitment to quality science teaching.	0.54
	6. to provide specialized training for teachers who work in urban areas.	0.67

TABLE IV (continued)

Aim	Item	Average △
	7. to provide specialized training for teachers who work in suburban areas.	0.58
	10. to help teachers become sensitized to the environment of their own classrooms.	0.56
	12. to help teachers recognize the inherent dignity of each of their students.	0.72

4. Even though average discrepancy values for seven aims were low (below 1) they are identified for consideration by the faculty. These items are listed below in order of decreasing discrepancy, and each is followed by a brief discussion.

A. Item 13: to help teachers learn to use value clarification techniques.
Average discrepancy: 0.98.

The faculty rated the use of values clarification of low importance in meeting the objectives of the Science Education graduate programs. However, they preferred that this area of study receive at least medium importance. Doctoral graduates and the two student groups ranked this item as currently receiving little attention; yet they judged that values clarification should receive more than medium importance, and it should be given even more emphasis.

B. Item 14: to help teachers set affective goals in their own science classes.
Average discrepancy: 0.98.

The Science Education faculty rated the aim related to affective goals between low and medium in importance. They judged that this aim should receive high priority. The other four groups concurred in the belief that affective goal setting should receive great emphasis. Although their perception of how it is presently handled is rated higher than by the faculty, it is not rated as high as they think it ought to be.

C. Item 15: to expose secondary teachers to elementary science programs and vice versa.
Average discrepancy: 0.94.

The faculty believed that broad exposure was of less than medium importance, but that it should be given greater importance in the graduate Science Education program. The other groups responded differently. The doctoral graduates saw this duel exposure as having more than medium importance. However, none of the groups gave this item the high importance given to it by the faculty.

D. Item 4: to make teachers conscious of their own teaching behavior.
Average discrepancy: 0.89.

All groups agreed that consciousness of their own teaching behavior is of medium importance in the program. However, all groups agreed that this aim should receive more than high importance.

E. Item 18: to help teachers improve and/or broaden their own knowledge of science.
Average discrepancy: 0.88.

The Science Education faculty believed broadening of science knowledge to be currently of more than medium importance. However, they believed that this area should be of high importance in the graduate Science Education programs. Both doctoral and masters graduates were in basic agreement with the faculty. On the other hand, the two student groups perceived this aim as of medium in importance in the program. They judged that this aim should be of very high importance.

(It should be noted that when asked for suggestions regarding the program through an open-ended question, these same groups, doctoral and masters students, asked for greater access to graduate science courses in order to broaden their knowledge of science. This response to an open question supports the reliability of the students' response to item 18 on the opinionnaire.)

F. Item 20: to provide opportunities for teachers to learn to use a variety of media techniques in their teaching of science, i. e., overhead projectors, microprojectors, film loops, etc.
Average discrepancy: 0,86.

The faculty perceived this item related to competence in utilizing media as receiving less than medium emphasis. Also, they believe it should be of medium importance. The doctoral graduates and both student groups evaluated this item similarly to the faculty, while the masters graduates ranked it as of higher importance. All of the groups differ somewhat from the faculty in their perceptions that media should receive higher importance in the graduate Science Education program.

G. Item 2: to help teachers develop a mature teaching style, i.e., one which integrates cognitive, affective, and technical skills.
Average discrepancy: 0,83.

The faculty saw this aim of the Science Education program as receiving medium importance; however, they indicated that it should receive much more emphasis. [The faculty

rating on this item resulted in the highest single discrepancy value (1.55) of any item on the opionionnaire.] The ratings on this item indicate that both graduates and students judged the performance of the Science Education program more positively than did the faculty.

It should be noted that faculty judgments were consistently harsher than the judgments of the other groups. This speaks well for the faculty in that they were generally more critical of programs they developed than were students and graduates of these programs.

Recommendations

Below are recommendations related to the seven items with highest discrepancy rating. The reader should remember in considering these recommendations that the minimal discrepancies grew out of slight differences in perceptions on the part of the various groups.

A. Since a course is available through another department, the recommendation is made that students who desire formal experience in values clarification techniques include this course as one of the electives in their graduate program.

B. Since there is considerable student satisfaction with experiences related to goal setting, (the faculty are not quite so satisfied) it is important for the faculty to examine the experiences related to this area. Note, however, that no drastic change in the nature of these experiences is called for.

C. To reduce discrepancy related to a broad k-12 experience two actions are recommended: The faculty should require all graduate Science Education students to obtain this experience. The second action called for is to advise graduate students to enroll in appropriate courses in Science Education for levels where they have no experience. The Science Education course offerings available presently are adequate to meet this need.

D. To reduce discrepancy regarding development of consciousness of one's own teaching behavior, the following recommendation is made: the graduate level program should include opportunity for actual supervision of graduate students in classrooms where science is being taught. To carry out this recommendation, videotape recordings of each teacher's classroom behavior should be made, followed by ample opportunity for analysis. A qualified, experienced faculty member should give supervision-type feedback on this video-taped teaching sample.

E. Increased dialogue should occur at the faculty and administrative level with appropriate departments within the College of Liberal Arts so that Science Education students may be able to take greater advantage of the many science offerings presently not available to them because of the times that these courses are offered. Since most graduate students in the Science Education are teaching or are otherwise employed full time during much of their degree program, the

Liberal Arts College should offer more late afternoon and evening classes for these students. The alternate is to offer financial help to allow for full time study.

F. A course or a workshop designed to develop facility in media techniques offered on an elective basis, seems to be a reasonable recommendation. Since such an offering is availalable through the Educational Media Department students can elect to enroll in this course. One alternative, or a means of complementing this media experience is for the science education faculty who use media techniques to include formal reference to these techniques, where appropriate, in their Science Education courses.

G. The data indicates a great deal of concern for development of teaching style on the part of both faculty and masters degree program graduates. Therefore, the faculty should consider this aim seriously and revise programs to reflect this concern.

Investigator's Professional Recommendations

Several recommendations beyond the data from this study seem appropriate. They grow out of professional experiences of several Teaching Associates at Temple University.

All doctoral students should have some of the experiences afforded through a Teaching Associateship during the minimum period of one year residency. These experiences should include: supervising student teachers, advising undergraduates, teaching courses in science methods, and a warm

peer-type relationship with the faculty. Out of the peer relationship grows encouragement to join and participate in professional groups such as the National Association for Research in Science Teaching and the Association of Educators of Teachers of Science, and attendance at credit and non-credit evening professional seminars. This aspect of the program will prepare students to assume self-fulfilling leadership positions in the community of science educators.

Final Statement

It is clear, from this study and from extended contact with many graduate students and graduates of the Science Education program at Temple University, that this group generally believes that they are well prepared to meet the challenges of an ever changing educational scene. If the faculty continues its "running" they will continue to keep up with the evolving educational needs of society and thus prepare their students effectively.

APPENDIX I

A. THE OPINIONNAIRE

The following statements have been made about the graduate programs at Temple University in Science Education. You are asked to respond to each one. Please read each statement and then indicate whether or not you think it is of importance in the total program in which you are or were involved. Then read the statement again and indicate the degree of importance you think should be placed on the particular item.

EXAMPLE

degree of importance

An aim of the graduate programs in Science Education is:		of no	of low	of medium	of high	of very high
to foster creative thinking in science	is/was should be					

degree of importance

An aim of graduate programs in Science Education is:	is/was should be	of no	of low	of medium	of high	of very high
1. to encourage teachers to make a strong commitment to qualify science teaching.	is/was should be					

An aim of graduate programs in Science Education is:		degree of importance: of no	of low	of medium	of high	of very high
2. to help teachers develop a mature teaching style, i.e., one which integrates cognitive, affective, and technical skills.	is/was should be					
3. to help teachers develop skills which will lead them to generate questions about their own studies	is/was should be					
4. to make teachers conscious of their own teaching behavior	is/was should be					
5. to provide teachers with useful classroom teaching techniques.	is/was should be					
6. to provide specialized training for teachers who work in urban areas.	is/was should be					

degree of importance

An aim of graduate programs in Science Education is:	is/was should be	of no	of low	of medium	of high	of very high
7. to provide specialized training for teachers who work in suburban areas.	is/was should be					
8. to train teachers to teach a specific national curriculum program, e.g., CHEMS, S.A.P.A, etc.	is/was should be					
9. to help teachers learn techniques which will enable them to lead their students to ask questions about science.	is/was should be					
10. to help teachers become sensitized to the environment of their own class rooms.	is/was should be					
11. to encourage teachers to develop learning materials which have an inquiry orientation.	is/was should be					

degree of importance

An aim of graduate programs in Science Education is:	is/was should be	of no	of low	of medium	of high	of very high
12. to help teachers recognize the inherent dignity of each of their students.	is/was should be					
13. to help teachers learn to use value clarification techniques.	is/was should be					
14. to help teachers set affective goals in their own science classes	is/was should be					
15. to expose secondary teachers to elementary science programs and vice versa.	is/was should be					
16. to help teachers set cognitive goals in their own science classes	is/was should be					
17. to help teachers set psychomotor goals in their own science classes	is/was should be					

degree of importance

An aim of graduate programs in Science Education is:	is/was should be	of no	of low	of medium	of high	of very high
12. to help teachers recognize the inherent dignity of each of their students.	is/was should be					
13. to help teachers learn to use value clarification techniques.	is/was should be					
14. to help teachers set affective goals in their own science classes.	is/was should be					
15. to expose secondary teachers to elementary science programs and vice versa.	is/was should be					
16. to help teachers set cognitive goals in their own science classes	is/was should be					
17. to help teachers set psychomotor goals in their own science classes	is/was should be					

degree of importance

An aim of graduate programs in Science Education is:	is/was should be	of no	of low	of medium	of high	of very high	
18. to help teachers improve and/or broaden their own knowledge of science.	is/was should be						
19. to help teachers become familiar with the instruments scientists use, i.e., spectrophotometers, pH meters, microscopes	is/was should be should be						
20. to provide opportunities for teachers to learn to use a variety of media techniques in their teaching of science i.e., overhead projectors, microprojectors, film loops, etc.	is/was should be						

B. BIOGRAPHICAL DATA SHEET

Please supply the following data. If you are presently enrolled in a degree program at Temple University please check the appropriate blank and give the anticipated date of your graduation.

Degree: M.S.E. _____ M. Ed. _____ C.A.G.S. _____

Date of Graduation _____

When did you begin this program? _____

If you have finished a degree program and are no longer enrolled please check the appropriate blank and give the date of your graduation.

Degree: M.S.E. _____ M. Ed. _____ C.A.G.S. _____

Date of Graduation _____

When did you begin this program? _____

Age _____ Sex _____ Undergraduate major _____

Present Position _____ Years in this position _____

Did you qualify for this position as a result of your graduate studies at Temple University? _____

To what extend did your studies in a graduate program at Temple University contribute to your feelings of success in this position?

1	2	3	4	5
a great deal		reasonable		not at all

Comments:

What suggestions would you make to improve the program you are in or have finished at Temple University?

APPENDIX II

CALCULATION OF THE KENDALL CORDANCE, X^2 AND P

A. "Should be" items.

B. "Is/was" items.

C. Discrepancies

A. RANKS ASSIGNED TO "SHOULD BE" ITEMS

	Items																			
Group	2	1	9	4	18	12	11	15	16	14	10	3	5	13	19	17	20	6	7	8
Faculty	1	2	3	4	5	6	8	8	8	10	11	12	13	14	15	16	17	19	19	19
Doctoral Graduates	2.5	1	2.5	8.5	5	8.5	8.5	12	8.5	14	13	8.5	4	16.5	16.5	15	8.5	19	18	20
Doctoral Students	6	2	9	4	1	8	7	17	13	12	11	10	3	16	14	18	15	5	20	19
Master Graduates	2.5	2.5	10	4.5	1	10	16	19	10	13	10	14	4.5	15	6	7	10	17	19	19
Master Students	6	1.5	4.5	11	1.5	9	4.5	18	15	12	10	7	3	16	8	20	14	13	17	19
E Ranks	18	9	29	32	13.5	41.5	44	74	54.5	61	55	51.5	27.5	77.5	59.5	76	64.5	73	93	96
$\frac{(\text{E Ranks} - \text{E Ranks}^2)}{n}$	1190.25	1892.25	552.25	420.25	1521.00	121.00	72.25	462.25	4.00	72.25	6.25	1.00	625.00	625.00	49.00	552.25	144.00	420.25	1640.25	1892.25

$$W = \frac{S}{1/12\ k^2\ (N2 - N)\ -k\ \sum T}$$

s = the sum of the squares = 12528

k = the number of groups judging = 5

N = the number of items = 20

$$T = \frac{E\ (tied^3 - tied)}{12} = 36.5$$

$W = .7619 \quad X^2 = 72.38 \quad df = 19 \quad p < .001$

B. RANKS ASSIGNED TO "IS/WAS"ITEMS

Items

Group	1	18	11	5	2	9	4	12	19	16	8	10	15	17	20	3	6	14	7	13
Faculty	1	2	3	4	5.5	5.5	8	8	8	10	11	12	14	14	14	16	17.5	17.5	19.5	19.5
Doctoral Graduates	2	3	7.5	6	4	7.5	15	9.5	12	11	14	5	9.5	13	16.5	1	20	16.5	18	19
Doctoral Students	1	11	3	2	5	8	4	7	13	10	19	9	17.5	14	17.5	6	16	12	15	20
Master Graduates	2	3	13.5	1	8.5	17	12	4.5	8.5	8.5	18.5	13.5	20	11	6	4.5	16	8.5	18.5	15
Master Students	2	8	3	1	4	5	6	11	15	10	17	9	20	19	16	7	13	14	12	18
E Ranks	8	27	30	14	27	43	45	40	56.5	49.5	79.5	48.5	81	71	70	34.5	82.5	68.5	83	91.5
$\frac{(\text{E ranks} - \text{E ranks}^2)}{n}$	1980.25	650.25	506.25	1482.25	650.25	90.25	65.25	156.25	16.00	9.00	729.00	16.00	812.25	342.25	306.25	324.00	900.00	256.00	930.25	1521.00

$$W = \frac{S}{1/12\ k^2\ (N^3 - N) - k \sum T}$$

where
s = the sum of the squares - 11734
k = the number of groups judging = 5
N = the number of items = 20
$T = \frac{\text{E tied}^3 - \text{tied})}{12} = 14$

$W = .7088\ X^2 = 67.34\ \ df = 19\ \ p < .001$

C. RANKS ASSIGNMENT

	Items																			
Groups	8	5		20	6	17	18	7	11	1	10	13	3	12	16	9	4	15	14	2
Faculty	1	2	3	4	5.5	5.5	7	8	9	10	11	12.5	12.5	14	15	16	17	18	19	20
Doctoral Graduates	2	6	7.5	20	17	11	3	14	10	4	1	19	9	12	15	13	18	5	16	7.5
Doctoral Students	1	4	15	17	11.5	16	20	7	2	5	13	19	3	8	11.5	6	9	14	18	10
Master Graduates	8	10.5	13	6	1.5	14.5	16	8	3	12	17	10.5	1.5	5	8	19	19	14.5	4	19
Master Students	2	1	19	16.5	10.5	8	20	4	5	9	12	15	13	16.5	6	10.5	3	18	14	7
$E\ R_{jg}$	14.00	23.50	37.50	43.50	46.00	35.00	66.00	41.00	29.00	40.00	54.00	76.00	39.00	55.50	55.50	64.5	66.00	69.50	71.00	63.50
$(R_j - \frac{ER_{j2}}{N})$	1260.25	676.00	144.00	36.00	12.25	210.25	272.25	72.25	420.25	90.25	20.25	702.25	110.25	36.00	36.00	225.00	272.25	400.00	462.55	196.00

$$W = \frac{S}{1/12\ k^2\ (N^3 - N) - k \sum T}$$

where
- s = the sum of the squares = 5654
- k = the number of groups juding = 5
- N = the number of items = 20
- $T = \frac{E\ tied^3 - tied)}{12} = 10.2$

$W = .3410 \quad X^2 = 32.3 \quad df = 19 \quad .02 < p < .05$

APPENDIX III

DEMOGRAPHIC DATA

A. Jobs of Graduates and Students.

B. Breakdown of Teaching Positions by Education Level.

C. Average Number of Years on the Present Job of Graduates and Students.

D. Response to Question on Job Satisfaction.

A. Jobs of Graduates and Students.

Group	% Teaching	% School Administration	% Other	% Unemployed
Doctoral Graduates	78	22	0	0
Doctoral Students	85	7	4	4
Masters Graduates	100	0	0	0
Masters Students	94	0	0	6

B. Breakdown of teaching positions by education level.

Group	Total % Teaching	Teaching Level % College	% T.A.	% Comm. Coll.	% Sec.	% Elem.
Doctoral Graduates	78	33	0	22	22	0
Doctoral Students	85	7	13	0	60	5
Masters Graduates	100	0	0	0	100	0
Masters Students	94	0	0	0	89	6

C. Average number of years on present job of Graduates and Students.

Group	Average number of years on job
Doctoral Graduates	2.3
Doctoral Students	6.2
Masters Graduates	4.6
Masters Students	3.9

D. Response to Question on Job Satisfaction: "To what extent did your studies in a graduate program at Temple University contribute to your success in this position?" A response of one indicated in the highest degree of attribution and five indicated the lowest.

Group	Median Responses
Doctoral Graduates	2.38
Doctoral Students	2.46
Masters Graduates	2.00
Masters Students	2.25

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